



Riedel, Johann Christian Karl Henry and Feng, Yanan and Azadegan, Aida and Romero, Margarida and Usart, Mireia and Baaslrud Hauge, Jannicke (2014) Measuring the commercial outcomes of serious games in companies: a review. In: Serious games development and applications: 5th International Conference, SGDA 2014, Berlin, Germany, October 9-10, 2014: proceedings. Lecture notes in computer science (8778). Springer, Cham, pp. 176-191. ISBN 9783319116228

Access from the University of Nottingham repository:

<http://eprints.nottingham.ac.uk/30686/1/SGDA%20Commercial%20Outcomes%20Paper%20OA%20version.pdf>

Copyright and reuse:

The Nottingham ePrints service makes this work by researchers of the University of Nottingham available open access under the following conditions.

- Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners.
- To the extent reasonable and practicable the material made available in Nottingham ePrints has been checked for eligibility before being made available.
- Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.
- Quotations or similar reproductions must be sufficiently acknowledged.

Please see our full end user licence at:

http://eprints.nottingham.ac.uk/end_user_agreement.pdf

A note on versions:

The version presented here may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher's version. Please see the repository url above for details on accessing the published version and note that access may require a subscription.

For more information, please contact eprints@nottingham.ac.uk

Measuring the Commercial Outcomes of Serious Games in Companies – A Review

Johann C.K.H. Riedel¹, Yanan Feng¹, Aida Azadegan², Margarida Romero³,
Mireia Usart⁴, Jannicke Baalsrud Hauge⁵

Johann.Riedel; Yana.Feng at Nottingham.ac.uk, Aida.Azadegan at uws.ac.uk,
margarida.romero at gmail.com, mireia.usart at esade.edu, baa at biba.uni-bremen.de

¹Nottingham University Business School, Nottingham, UK; ²School of Computer Science,
University of the West of Scotland, Paisley, UK; ³Université Laval, Québec, QC G1V 0A6,
Canada; ⁴ESADE Law & Business School, 60-62 Avenue Pedralbes, Barcelona, Spain, ⁵BIBA,
Hochschulring 20, D-28359, Bremen, Germany.

Abstract.

The objective of this paper is to review the work on the measurement of the commercial outcomes of serious games in companies and to provide a framework for their measurement in companies. The literature on the evaluation of training and in particular serious games is presented. A systematic literature review of studies of the impacts of business games in companies was undertaken. The paper summarises the existing studies on measuring the effectiveness of serious games in companies. A search of the grey literature was also conducted to establish what kinds of commercial outcomes have been measured and how. Finally, the paper presents some examples of measuring the commercial outcomes. It also provides some advice on how to measure commercial outcomes.

Keywords: Serious games, commercial outcomes; evaluation framework; evidence; literature review

1 Introduction

The objective of this paper is to review the work on the measurement of the commercial outcomes, that is, organizational impacts, of serious games in companies and non-educational organizations. The concept of serious Games (SG) effectiveness in the field of business is described. We start by introducing Kirkpatrick's model of learning assessment. Then the concept of SG effectiveness in companies is presented along with an evaluation timeframe framework for measuring the commercial outcomes of SGs.

The paper summarises the existing literature on measuring the effectiveness of serious games in companies, along with some example studies. A systematic literature review of studies of the commercial impacts of SGs in companies was conducted. The literature suffers from a dearth of studies; and the few studies that have been conduct-

ed have many weaknesses. The few studies identified are summarised. This literature review was complemented by a search of the grey literature on the internet to establish what kinds of commercial outcomes have been measured and how. Finally, the paper presents some examples of measuring commercial outcomes. It also provides some advice on how to measure commercial outcomes.

1.1 Kirkpatrick's Framework for Training Effectiveness

Kirkpatrick devised his framework for training evaluation in the late 1950s (1959). Although Kirkpatrick's four levels of evaluation are known in professional contexts and management education, his model has not been recognized by the community of researchers in the field of psychology or the learning sciences. The model, shown in Table 1, is composed of four levels: reaction, learning, behaviour and results (1994).

Table 1. Kirkpatrick's Four Levels of Training Effectiveness

Kirkpatrick's 4 levels	
Level 1: Reaction	To what degree participants react favourably to the training
Level 2: Learning	To what degree participants acquire the intended knowledge, skills, attitudes, confidence and commitment based on their participation in a training event
Level 3: Behaviour	To what degree participants apply what they learned during training when they are back on the job
Level 4: Results	To what degree targeted outcomes occur as a result of the training event and subsequent reinforcement

A fifth level, ROI (return On Investment) has been added by Phillips (2007). See Bartel (2000) for a review of this approach. TrainingZone (a web resource on training) make the point that although training professionals are adept at designing and delivering training, they are not so good at ensuring participants actually apply what was learned in their job (TrainingZone). In order for this to occur participants have to apply the behaviours they learnt in the training to their daily job – only then will it result in commercial outcomes. These outcomes could be both financial in terms of costs saved or increased sales, but they can also be improved processes, improved customer service, etc. This diversity of potential outcomes presents a challenge to trainers and others who wish to determine the commercial effectiveness of SGs.

The use of the Kirkpatrick model in Game Based Learning (GBL) in general, and in Serious Games (SG) in particular has been limited, and mostly conducted during the last 10 years. Most of the uses of the Kirkpatrick's model in GBL and SG research are related to the use of SG in professional contexts. Johnson and Wu (2008) used the

serious game IraqiTM in the context of Marine Corps training, and analyse the impact of the SG IraqiTM, using the level 3 and 4 of the Kirkpatrick model: “tactical IraqiTM training led to improved on-the-job performance (a Kirkpatrick level 3 result) and this in turn contributed to improved organizational outcomes (a Kirkpatrick level 4 result)” p. 521. In a review of SGs' learning outcomes, O'Neil et al. (2005) found “only two studies involved Level 3 (on-the-job changes due to training), and one study involved Level 4 (benefits to the employer, for example: cost effectiveness).” Martínez-Durá and colleagues (2011) studied effectiveness in safety training SGs. Different games were discussed by the authors, divided into three different domains: health and safety in construction, public safety and pedestrian safety. In these contexts, two types of games were identified: interactive games, where the player must undertake different tasks in order to win the game, and “observation-based” games, concerning safety regulations. Following the Kirkpatrick model, the authors focused on level 3 as the most important for safety training. They argue that the transfer level aims to evaluate to what extent the knowledge and skills acquired through the game are used by the learner. Level 4 (results), are important: a reduction in the number of work related accidents.

2 Serious Games' Evaluation Framework

As mentioned above the learning effectiveness of serious games has been widely studied in the educational context. A systematic framework for evaluating serious games has been produced by Mayer et al. (2013). Mayer and colleagues aimed to understand to what extent, and which factors, of SGs contribute to advanced learning, and if the lessons learnt can be transferred to the real world. In their study, focused on the requirements and design principles for a comprehensive social scientific methodology for the evaluation of SGs, they focus on 12 different SG experiences in formal and informal learning environments, for different ages and contexts. The key factors they identified include: organizational commitment, organizational characteristics (structure, culture, process), participant characteristics (position, expertise, personality, learning style), participant socio-demographics, and participant motivation. After their review, the authors highlight the lack of studies providing high-quality evaluation frameworks for SGs. Referring to Kirkpatrick's four levels for evaluating training they admit (p. 9) that “this model is difficult to use for exploratory or explanatory hypothesis generation and testing.” Furthermore, there are even fewer evaluation frameworks of game-based learning in higher education, let alone professional, in-company training, or group and organizational learning.

The standard evaluation technique has been the quasi-experimental design with pre- and post-gaming tests (Mayer et al. 2013; Bellotti et al., 2013; Baalsrud Hauge et al., 2014). For the case of evaluating commercial outcomes this model needs to be refined, see Fig 1 below.

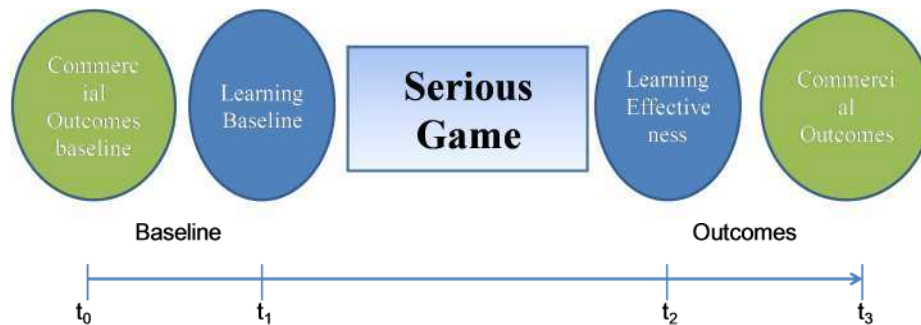


Fig. 1. SG Evaluation Timeframe Model

The above SG evaluation timeframe model shows that before the impact of a serious game can be determined, it is necessary to determine the baseline level of knowledge (learning) of the participants and the baseline level of the targeted commercial outcomes. These have to be measured at different times and places/contexts: the commercial baseline needs to be measured in context at the workplace and this has to be done some time before the serious game (t_0). This measurement may have to be done some months before the serious game (due to difficulties of measurement or other constraints). The learning baseline is typically measured in the training room immediately prior to participation in the serious game (t_1), and typically involves the use of questionnaires (Mayer et al, 2012). The learning outcomes are also typically measured immediately after the serious game (t_2), again using questionnaires. However, the commercial outcomes need to be measured in context at the workplace and the measurement needs to be delayed until the SG's impacts have had chance to take effect (t_3) – this again could take some months. It is also advisable to make the same measurements of a control group who are not subjected to the SG, so as to show that the SG produced the observed outcomes.

There is an issue with determining the commercial outcomes of a serious game. This is an SG specific factor – if managers have a means to measure the impact of the serious game, particularly its commercial impact, they would be more willing to adopt. However, in practice it can be difficult to identify the outcome. There is a further difficulty in that some of the outcomes, eg. cultural change, change of mindset, soft-skills development and change of behavior are hard to quantify and therefore hard to measure. For example, observation of behavior can be used; however, unless an experienced researcher carries it out, the results may be unreliable. It would be better to use objective, or factual, outcomes in the measurement. Hence, further research is needed to identify what the commercial impacts of serious games are and how they can be measured. The following table illustrates some of the behaviours and accompanying outcomes that can result from serious games. Behavioural change can occur at the individual, team and organizational levels.

Table 2. Classification of Training Outcomes

	Individual Level	Team Level	Organisational Level
Level 3: Behavior	Change in attitudes	Improved team-working	Change in organisational processes/ practice
	Change in individual behavior	Improved decision-making	Cultural change
	Improved skills	Improved problem solving	Strategic change
			Reduction in resistance to change
Level 4: Results	Non-Financial Outcomes	Metrics	Financial Outcomes
	Reduced time	<i>Financial</i>	Increased sales
	Improved productivity		Reduced costs
	Improved quality	<i>Non-financial</i>	Reduced warranty, insurance/ compensation claims
	Fewer adverse events		Increased sales
	Improved Customer service		
	Improved health outcomes		

The above table shows that even non-financial outcomes, such as reduced time to complete work and improved productivity can be measured with financial metrics. Other non-financial outcomes cannot be easily measured in financial terms – such as improvements in quality, in customer service and health outcomes. The next section reviews the existing studies in the academic literature.

3 Evidence of the effectiveness of SGs in companies

In the field of medical education, SGs are relatively new. de Wit-Zuurendonk and Oei (2011) made a literature review on the effectiveness of SGs as a training method for future doctors. They argue that simulations have long been considered as effective in the medical field, and that games could also be effective because learning takes place within contexts that are meaningful to the student. Nevertheless, results of their study show that SGs effectiveness has not been conclusively demonstrated in this particular area, when compared with military training.

When measuring the training effectiveness of SGs, Oprins and Korteling (2012) used a control group receiving conventional on-the-job training. They measured both

performance and competence by observation and self-assessment. Results showed that both variables were higher for the group playing a SG.

In order to clarify the question a systematic literature review was conducted in order to identify the evidence of the effectiveness of serious games used in companies. We want to find studies, or evaluations, of serious games that have been carried out in companies, or at the very least with employees. Thus we ruled out papers which were simply descriptions of business related games or reflections on the potential of serious games. We also excluded from consideration games for business which have been evaluated in an educational context or with student participants – as we are looking for evidence of the impact of serious games on companies. According to Mulrow (1994), systematic literature review has been found to provide the high quality and most efficient method for identifying and evaluating extensive literatures. The current theoretical and empirical literature is evaluated in order to provide recommendations for future research directions for scholars in serious games, training and development, human resource management, computer science and social psychology.

The first step in the literature review is to define the set of keywords to use for searching the databases. The process of identifying the search terms and keywords was an iterative process, several meetings were held within the review team to decide on the search strings that are most appropriate for the review. After discussions, five search terms were selected: ‘company’, ‘evaluation’, ‘study’, and ‘business game’ or ‘business simulation’. During the search, we excluded ‘game theory’ because a large number of articles using game theory as theory or experimental studies were found which are irrelevant to the current research. These five key search terms were selected because we were interested in the evaluation of business games used in companies, and these five key search terms can best reflect the parameters of this review. In order to ensure the comprehensive coverage of the literature search, we did not refine the type of game, such as serious game, video game etc., but rather, we included any business relevant game which has been used or evaluated in companies.

We focused on peer-reviewed full-text English-language scholarly journal articles when conducting the literature search. According to Armstrong and Wilkinson (2007), journal articles are likely to have the highest impact on the field and can be considered validated knowledge. We also included conference proceedings, given that serious games is an emerging field so there might be relevant conference papers which have not yet been published in journals. There is also a tendency for computer science related research to be published in conference proceedings rather than journals (eg. ACM’s HCI conference – CHI).

We began with a keyword search using several electronic databases, including Science Direct, ProQuest/ABI, ACM Digital Library (DL), IEEE XExplore Digital Library and the Academy of Management database. These databases were selected to cover the following disciplines: social science, business and management, computer science in order to maximise the chances of finding relevant articles. The specific reason for selecting Science Direct is that this is a leading scientific database in both science and social science areas. More than 2,500 journals and almost 20,000 books can be found from Science Direct. ProQuest/ABI is one of the most comprehensive business databases. It includes in-depth coverage for over 3,730 publications, with

more than 2,670 available in full text. We also selected the ACM and IEEE XExplore digital libraries, since they have extensive coverage of the databases in computer science and information technology. The ACM Digital Library is the most comprehensive collection of full-text articles and bibliographic records covering the fields of computing and information technology, it also indexes the Springer collection. The full-text data-base currently consists of more than 44 high impact Journals as well as more than 275 Conference Proceedings. The IEEE XExplore digital library database provides full text access to more than 140 technical journals and approximately 900 annual conference proceedings published by the Institute of Electrical and Electronics Engineers (IEEE) and the Institution of Engineering and Technology (formerly the Institution of Electrical Engineers). We also included the database of the Academy of Management, since it publishes leading journals in the business and management field and provides the highest quality papers. The reason for us to include this database is to identify if there are papers on serious games so that we can learn from their best research practice. The Academy publishes five journals: articles published in the Academy of Management Journal (AMJ) empirically examine theory-based knowledge; the Academy of Management Review (AMR) provides a forum to explicate theoretical insights and developments; The Academy of Management Learning and Education (AMLE) provides a forum to examine learning processes and management education; the Academy of Management Perspectives (AMP) publishes accessible articles about important issues concerning management and business; and the Academy of Management Annals provides up-to-date, comprehensive examinations of the latest advances in various management fields. Each volume features critical research reviews written by leading management scholars.

Table 3. Summary of the database search results, showing the number of articles found

<i>Key search terms</i>	Business game + company + evaluation	Business game + company + study	Business simulation + company + evaluation	Business simulation + company + study
Science Direct	3	15	10	53
ProQuest/ABI Inform	4	14	5	12
ACM digital library (includes Springer publications)	5	0	0	0
IEEE XExplore digital library	1	3	0	0
<i>Key search terms</i>	<i>Game + company</i>		<i>Business simulation</i>	
Academy of Management	5		5	

After the literature search of the databases, a total of 137 articles were found (see Table 3 above). Following the rigorous methodology used by Tranfield, Denyer & Smart (2003), the reviewer reviewed all the 137 articles in-depth, articles that met all the inclusion criteria and which manifested none of the exclusion criteria were selected. For example, to be included in the review, an article had to address games/ simulations used for education, training or learning purposes in companies. Other studies, for example, on simulations (especially with equations) which are used for modelling real organisational processes and games that are used for student education purposes (except executive education) were not included. This resulted in a total of 29 articles. As the decision regarding inclusion and exclusion remain relatively subjective (Tranfield, Denyer & Smart, 2003), after the first selection process, a number of discussions were held within the review team to further discuss the criteria for selecting articles. Finally a total number of six articles were identified. A summary of the studies is in Table 4.

As can be seen in Table 4, serious games have been found to be an effective teaching tool, as, for example, it has increased learners' participation and interest in the study of insurance company operations (Trifschmann, 1976). The findings of Ben-Zvi (2007) demonstrated the potential for using business games as an educational tool for teaching management information systems (MIS) and Decision Support Systems (DSS). In Pourabdollahian, Taisch & Kerga's (2012) study, a high level of engagement among learners was exhibited during game play based on the evaluation framework adopted. In addition, Wolfe (1975) found that management games could reward rational policy and decision making practices. Seven broad groupings' of performance behaviours were also identified in Wolfe's (1975) research.

Of these six studies, four studies used executive education students, one study used a combination of both students and company employees and only one study was carried out with engineers and project managers in a company in Italy. The type of game used ranged from an insurance game, a management game, a concurrent engineering (new product development) game and other business games. The application domain, therefore, included insurance, HRM, business policy and decision making, engineering and information systems. The levels of analysis/operation in the games included the individual, team and firm levels. The evaluation methods employed included experiments, for example, Cook (1967), which simulated the operations of a multi-firm, one-product industry and Wolfe and Luethge (2003), who conducted quasi-experiments with senior managers in companies and made comparisons between the engaged firms and unengaged firms in terms of their returns on equity and assets and earnings per share. Four studies used questionnaires, to measure participants' attitudes (Cook, 1967), the level of engagement among learners (Pourabdollahian, Taisch, & Kerga, 2012) and the use and contribution of information systems (Ben-Zvi, 2007).

The limited number of evaluation studies found in the literature may be due to several reasons. First, the fact that companies who adopt serious games would not wish to disseminate the evaluation information to their competitors, so it remains confidential and hence difficult for scholars to access. In addition, it seems difficult to develop appropriate measures for the learning outcomes, especially for measuring

soft skills outcomes (for example, interpersonal skills, leadership and negotiation). Management and HR researchers need to develop validated measures for these so that they can be applied in a standard way to evaluate serious games. There is also the lack of evaluation opportunity problem – serious games can be developed and deployed without evaluations being performed due to the lack of evaluation experts/researchers being there at the time to evaluate the impact. For the studies identified in the literature, although they provide interesting evidence for the use of serious games in companies, a number of methodological issues have been found as well. For example, the performance measures used in Wolfe and Luethge (2003) seem to be weakly formulated. They used in-game indicators, i.e. the return on equity and assets and earnings to evaluate participants' game performance. The use of in-game measures is problematic because we need to be sure that the game generates the correct measures – that is the fidelity and validity of the game's algorithms needs to be high. Separate studies of this validity of the game would need to be carried out, without learning outcome indicators; however, it is difficult to identify the learning effects from the game. Other methodological problems were present in the studies too, in Trifschmann's (1976) research, no sample size was reported and it is thus difficult to evaluate the validity of study.

Table 4. Summary of the evaluation studies of serious games used in companies

Game	Authors	Methodology			Findings	Individual/ Team Game	Application domain
		Evaluation method	Sample size	Outcomes measured			
The UCLA Executive game	Cook (1967)	Phase I: Experiment, which simulates the operations of a multi-firm, one-product industry	Phase I: 120 students from a university	Attitude, Frequency of feedback, Job performance	Attitudes of participants and performance results are directly related to the frequency of feedback on performance,	Team	HRM
		Phase II: Questionnaire	Phase II: 134 managers from 59 companies				
An insurance game	Trifschmann (1976)	Experiment (This is inferred from the text, as there is no explicit mention of methodology)	No mention of sample size Also no mention if they are executive students or not.	Game performance and their oral and written reports	The game was found to be an effective teaching tool, as it increased student participation and interest in the study of insurance company operations.	Team	Insurance
A management game	Wolfe (1975)	Interview	254 students from five sections of a senior-level business policy course	Effective performance behaviours	7 broad groupings of performance behaviours were identified; management games rewarded rational policy and decision making practices; and chance played no consistent part in company success.	Team	Business policy and decision making

Game	Authors	Methodology			Findings	Individual/ Team Game	Application domain
		Evaluation method	Sample size	Outcomes measured			
The global business game	Wolfe & Luethge (2003)	Quasi-experiments	Senior managers in companies, MBAs No mention of sample size	Average quarterly earnings	The engaged firms who participated in the game obtained superior results; while the uninvolved firms fared the worst. The player-led companies beat the copycats and the uninvolved firms on their return on equity and assets, and earnings per share.	Team	Organisational Behaviour, corporate governance
The Set Based Concurrent Engineering (SBCE) Game	Pourabdollahian, Taisch, & Kerga (2012)	Questionnaire	36 engineers and project managers in the Carel Company in Italy	The level of engagement was measured	The results showed that a high level of engagement among learners is exhibited based on the evaluation framework adopted.	Team	New product development, engineering design.
A business game	Ben-Zvi (2007)	Questionnaire	18 companies, consisting of 90 graduating MBA students.	A number of relevant variables: use of systems, contribution of systems, association with systems and user satisfaction.	The findings demonstrated the potential for using business games as an educational tool for teaching management information systems (MIS) and decision support systems (DSS).	Team	Information systems

This systematic literature review has found very limited empirical evidence for the effectiveness of SGs in companies. The next section reviews examples of evaluations of SGs in companies located on the internet. These studies have not been published in peer reviewed journals and so cannot be relied upon as being rigorously conducted, or having confidence in the findings

4 Examples of Commercial Outcomes of Serious Games

This section of the paper presents case studies of SG commercial effectiveness from three different companies Deloitte, Samsung and IBM (two cases) and examples of gamification effectiveness.

4.1 Samsung Electronics

Electronics firm, Samsung, planned to create more user-generated content and traffic for its global website – which often go hand-in-hand from an essential search engine optimization perspective for online marketing. Samsung created a social media-based loyalty program utilizing serious game principles.

Samsung, mixed frivolity with serious business initiatives and used gamification platform of Badgeville to fuel competition among visitors of the website and affect their online behaviour. Badgeville serious gaming platform, can track users' performance data to motivate behaviour, reward top performers, and create real-time notifications to engage inactive users. The Badgeville game let users level up, unlock badges, and gain subsequent rewards and recognition. Samsung, in return, saw 66 percent more users submitting 447 percent more product answers on its global Web site. Even more impressive, the user-generated content prompted 34 percent of users to put 224 percent more items in shopping carts.”

<http://www.designingdigitally.com/blog/2014/03/ibm-samsung-allstate-see-high-roi-through-serious-games#axzz31RcNKCXD>

<http://www.thegamifiers.com/customers-list/case-studies/123/samsung/>

4.2 IBM – Innov8 case study

IBM's Innov8 is a serious games used for marketing purposes that explain business process management to college students and city planning processes to CEOs, presidents, COOs and other leaders.

Innov8, a serious game created on the Vicious engine, was rolled out as an IBM academic initiative to explain Business Process Management (BPM) to students. This means IBM has a foot in the door with rising generations. Students going through college and learning about BPM learn it through an IBM product with IBM branding attached to it. This game gives IBM a presence in schools, making an impression on the future leaders of the world and future potential customers. Moreover, Innov8 became the top brand for IBM within a few days of it going live in 2009.

<http://www.designingdigitally.com/blog/2014/03/ibm-samsung-allstate-see-high-roi-through-serious-games#ixzz31VNIwbhq>

Innov8: CityOne is now IBM's top lead generator. The pitch of the game is to "Level-up your skills and discover how to make our Planet smarter, revolutionize industries and solve real-world business, environmental and logistical problems." CEOs, Presidents, COOs and other top executives across the globe embraced the game. The ROI for *Innov8: CityOne* revealed that in five months, the game resulted in 100x the investment put into it. Tracking the people who played and who bought resulted in tremendous sales for IBM. *Innov8: CityOne* is free to play but registration is required to make it possible to track the results. Moreover, *Innov8: CityOne* now serves as a sales tool for IBM salespeople. The game can be customized for sales representatives based on the needs of clients. Creating a platform where sales representatives can cater to client's pain points proved to be an incredibly useful feature of *Innov8: City One*.

<http://www.ignitesocialmedia.com/games/serious-games-the-new-frontier-of-online-marketing/>

4.3 Deloitte Business Simulation game

The Deloitte Business Simulation game is designed to train employees in corporate responsibility and sustainability. The game enables players to experiment with a realistic model of their company and its potential future scenarios. During the game, the players go through various scenarios and are confronted with the consequences of their decisions just as in the real world. This hands-on experiential learning helps to sharpen management skills through practice and feedback.

CoCo Sim, developed by Front Square, is a game based in a fictional New York-based chocolate store, where the player must manage cash flow and stock levels in order to achieve a high customer satisfaction level while also remaining profitable. The game integrates modules on business process, problem solving and basic accounting. Players' knowledge and skills are applied to the game in order to improve the score. Players' skills are tested with regular questions and the combined game and question scores are then posted on a leader board to help drive competition and engagement. Line managers and HR managers have access to the learning analytics to see who is doing well and who needs performance intervention.

4.4 Gamification Cases

Interest and application of gamification has been increasing in recent years. Business can apply gamification to improve both external and internal interactions and engagement. In terms of *External or Customer Engagement* gamification enables businesses to drive high-value customer behaviour. While it cannot add value to a product or service, its value can be made more visible if applied in the right way – keeping in mind the overall organizational goals, user experience, measurement and analytics needs, design of incentives, and information technology considerations.

- Companies like Verizon have leveraged gamification to increase the time spent by users on their website by 30%, with a 15% increase in page views.
- Nike used gamified feedback to drive over 5,000,000 users to beat their personal fitness goals.
- Another example is the gamification strategy used by the company Marketo. Marketo wanted to increase the adoption of, and accelerate customers to maturity with their software even more quickly by identifying and rewarding high-value behaviours - like asking questions, submitting and voting on ideas, watching videos, etc. Through this gamification they produced an impressive increase in the daily activities that deliver healthy, active, engaged communities. The company layered Badgeville (the provider company) games on their community, resulting in 67% more engagement, 51% more active members and 10% more engagements per member (Pattabhiram, 2013).

In terms of *Internal or Employee Engagement* businesses stand to benefit from gamification in the workplace by improving employee motivation and hence driving better results. Companies like Badgeville, Achievers and Bunchball currently provide applications that capture and analyze behavioral and other user data of employees to facilitate rewards and recognition.

- LiveOps was able to witness an 8-10% increase in sales by providing timely performance feedback to its call center agents as part of a gamification initiative.
- Deloitte was able to reduce the time taken for training programs by 50% through the use of gamification, while increasing student involvement.
- Extraco Bank and Lawley Insurance were able to increase customer acquisition by 700% and sales activity by 15 times, respectively.

The Deloitte Leadership Academy, a digital executive training programme for more than 10,000 senior executives in over 150 companies around the world, partnered with Badgeville to add game mechanics to its leadership training programme to drive desired behaviours and increase engagement. The programme is delivered to senior executives via an online portal or mobile devices. As players contribute, share knowledge and complete learning programmes, they receive badges, rewards and can share these accomplishments on sites such as LinkedIn, improving their reputation in their field of expertise. After three months of use the results were impressive in terms of improved engagement and module completion (Donovan, 2012): a 46.6% increase in the number of users that return to the site daily; a 36.3% increase in the number of users that return to the site weekly; an average of three badges per active user. One user has earned the Leadership Academy Graduate badge which was expected to take 12 months to achieve.

http://www.mu-sigma.com/analytics/thought_leadership/decision-sciences-gamification.html

5 Conclusion

This paper has reviewed the work on the measurement of commercial outcomes of serious games in companies. The literature on the approach to the evaluation of serious games was summarized. A framework for evaluating commercial outcomes of serious games was presented, along with some examples and guidance on how to conduct evaluations. A systematic literature review was conducted to identify research studies carried out in companies, or with company participants. In summary, although serious games have been used for the purpose of training for a long time, limited empirical evidence was found for the effectiveness of serious games in companies. Serious games have two main effects in companies – learning outcomes and commercial outcomes. The few studies found suffered from several weaknesses – poor methodology and measures. An internet search revealed a selection of companies using serious games and reporting commercial outcomes. SGs were used for both internal engagement with employees (either in training or the gamification of corporate platforms) or with customers (as advertising or gamification of customer education). In both these types of use significant increases in participation/engagement were seen.

Future research is desperately needed to evaluate the effectiveness of serious games in companies. Development of more appropriate evaluation methods is also important in order to more accurately assess the effectiveness of using games in companies. Measures of the learning effects need to be developed, drawing on the many evaluation studies conducted in the educational context. Secondly, measures of the commercial impacts of serious games need to be developed – only if we can show that companies can gain commercial benefits will they be convinced to invest in serious games. There needs to be proper research on the benefits of gamification in companies. Gamification has drawbacks – promoting badge collection/ competition at the expense of learning/ behavior improvement. Has this been seen in companies and what do they do to counter it? A further recommendation is that serious games developers and evaluation researchers need to build strong relationships, so that the developed games can be evaluated with rigor and at low cost. Once we have good quality evidence from rigorous studies it will enhance the acceptance of adopting serious games in industry.

Acknowledgements. The research reported in this paper has been partially supported by the European Union, particularly through the project GaLA: The European Network of Excellence on Serious Games (FP7-ICT-2009.4.2-258169) www.galanoe.eu, www.seriousgamessociety.org

6 References

1. Baalsrud Hauge, J., Boyle, E., Mayer, I., Nadolski, R., Riedel, J. C. K. H., Moreno-Ger, P., Bellotti, F., Lim, T., & Ritchie, J. M. (2014). Study design and data gathering guide for serious games' evaluation. In T. M. Connolly, T. Hainey, E. Boyle, G. Baxter, & P. Moreno-

- Ger (Eds.), *Psychology, Pedagogy, and Assessment in Serious Games*. (pp. 394-419). IGI Global. 10.4018/978-1-4666-4773-2.ch018.
2. Bartel, AP. (2000). "Measuring the Employer's Return on Investments in Training: Evidence from the Literature," *Industrial Relations*, 39(3), 502-524.
 3. Bellotti, F; Kapralos, B; Lee, K; Moreno-Ger, P. and Berta, R. (2013) "Assessment in and of Serious Games: An Overview," *Advances in Human-Computer Interaction*, vol. 2013, Article ID 136864, 11 pages, 2013. doi:10.1155/2013/136864
 4. Ben-Zvi, T. (2007) Using business games in teaching DSS, *Journal of Information Systems Education*, 18(1), pp113.
 5. Cook, D.M. (1967) The effect of frequency of feedback on attitudes and performance, *Journal of Accounting Research*, 5, pp213-224.
 6. Connolly, T.M., Boyle, E.A., MacArthur, E., Hainey, T., & Boyle, J.M. (2012). A systematic literature review of empirical evidence on computer games and serious games, *Computers & Education*, 59: 661-686.
 7. de Wit-Zuurendonk, L. D., & Oei, S. G. (2011). Serious gaming in women's health care. *BJOG: An International Journal of Obstetrics & Gynaecology*, 118(s3), 17-21.
 8. Donovan, L. (2012) *The Use of Serious Games in the Corporate Sector. A State of the Art Report*. Learnovate Centre, December 2012.
 9. Johnson, W. L., & Wu, S. (2008) Assessing aptitude for learning with a serious game for foreign language and culture. In *Intelligent tutoring systems* (pp. 520-529). Springer, Berlin Heidelberg.
 10. Kirkpatrick D. L. (1959) Techniques for evaluating training programs. *Journal of American Society of Training Directors*, 13 (3): pp21-26.
 11. Kirkpatrick, D.L. (1994) *Evaluating Training Programs: The Four Levels*, San Francisco: Berrett-Koehler Publishers.
 12. Martínez-Durá, M., Arevalillo-Herráez, M., García-Fernández, I., Gamón-Giménez, M.A. & Rodríguez-Cerro, A. (2001) *Serious Games for Health and Safety Training*. In Prensky, M. (2001). *Digital game-based learning*. New York: McGraw-Hill.
 13. Mayer, I., Bekebrede, G., Hartevelt, C., Warmelink, H., Zhou, Q., van Ruijven, T., Lo, J. Kortmann, R. & Wenzler, I. (2013). The research and evaluation of serious games: Toward a comprehensive methodology. *British Journal of Educational Technology*. doi:10.1111/bjet.12067
 14. Mulrow, C.D. (1994) 'Systematic reviews: Rationale for systematic reviews', *British Medical Journal*, 309 (6954): 597-599.
 15. O'Neil, H.F. Wainess, R. & Baker, E. (2005). Classification of learning outcomes: evidence from the computer games literature. *The Curriculum Journal*, 16(4), 455 – 474.
 16. Oprins, E. & Korteling, H. (2012). Transfer of gaming: effectiveness of a Cashier Trainer. <http://www.just.nl/en/files/2012/11/TNO-paper-CASA-2012-Singapore.pdf>
 17. Pattabhiram, C. (2013, May 17). Expanding and Engaging Marketo's "Marketing Nation". Retrieved from <http://blog.badgeville.com/2013/05/17/engaging-marketos-marketing-nation/>
 18. Phillips, J.J. (2007) *Measuring ROI – Fact, Fad, or Fantasy*, ASTD White Paper, April 2007.
 19. Pourabdollahian, B., Taisch, M., & Kerga, E. (2012) Serious games in manufacturing education: Evaluation of learners' engagement, *Procedia Computer Science*, 15, pp256-265.
 20. Tranfield, D., Denyer, D. and Smart, P. (2003) Towards a methodology for developing evidence-informed management knowledge by means of systematic review, *British Journal of Management*, 14(3), 207-222.
 21. TrainingZone, <http://www.trainingzone.co.uk/topic/kirkpatrick-new-world-level-3/155784>

22. Trifschmann, J.S. (1976) Teaching insurance with an insurance management computer game, *Journal of Risk and Insurance*, 43(1), pp43.
23. Wolfe, J. (1975) Effective performance behaviors in a simulated policy and decision making environment, *Management Science*, 21(8).
24. Wolfe, J., & Luethge, D.J. (2003) The impact of involvement on performance in business simulations: An examination of Goosen's 'know little' decision making thesis, *Journal of Education for Business*, 79(2), pp69.

Riedel, JCKH; Feng, Y; Azadegan, A; Romero, M; Usart, M. & Baalsrud Hauge, J. (2014) Measuring the Commercial Outcomes of Serious Games in Companies – A Review, In: Ma, M; Oliveira, MF; & Baalsrud Hauge, J. (Eds) *5th International Conference on Serious Games Development and Application, SGDA 2014, Berlin, Germany, October 9-10, 2014, Proceedings*. Lecture Notes in Computer Science, LNCS 8778, pp176-191. Springer, Switzerland.
http://dx.doi.org/10.1007/978-3-319-11623-5_15.